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Analysis

Look at me Saving the Planet! The Imitation of Visible Green Behavior and its Impact on the Climate Value-Action Gap☆

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ABSTRACT

Examining the regional distribution of 15 different Greenhouse Gas Mitigation Practices (MPs) across Australia, we study the tendency for consumers to imitate visible pro-environmental behavior in their local region. While there is a great deal of variation in the specific type of MPs adopted by consumers located in the same region, ANOVA results suggest that they tend to adopt a similar number of MPs as their neighbours. Using discrete choice modelling, our results suggest that this is due to the peer adoption of certain visible MPs, such as using public transport or car-pooling, encouraging agents to adopt other types of visible MPs. However, the character of this spillover is limited in that visible pro-environmental behavior does not appear to influence the adoption of non-visible MPs. We also find that social imitation patterns help individuals overcome the observed gap between their stated concern about climate change and their propensity to act on this concern, known as the climate 'value-action' gap. Policy implications for designing effective green nudges are discussed.

1. Introduction

The recent establishment of the United Nations Framework Convention on Climate Change in 2015 has given renewed impetus to global efforts to mitigate climate change (Kinley, 2017). In terms of promoting sustainable consumption, most of the debate has focussed on how governments can regulate or provide pecuniary incentives to reduce the carbon footprint of households (Bertram et al., 2015; Wagner, 2006). Beyond government action, non-state market adaptation processes, i.e. how consumers and producers themselves may act to better adapt to climate change, are increasingly being recognized as central to national climate change strategies (Jackson, 2005; Kinzig et al., 2013). An open question here is how the prosocial nature of humans can be harnessed to encourage consumers to voluntarily reduce their carbon footprint. Considerable evidence suggests that humans possess a behavioral predisposition to cooperate, share resources and make sacrifices for the greater good (Richerson and Boyd, 1998; Ostrom, 2010). Throughout human history, this tendency has played an important role in enabling the human species to thrive and prosper (Gowdy and Krall, 2015). Moreover, the voluntary adoption of Greenhouse Gas Mitigation Practices (MPs), such as using public transport, saving electricity and insulating houses, has the potential to significantly reduce household carbon emissions by as much as 20% (Dietz et al., 2009). There is also ample evidence of widespread concern about climate change in the population: survey after survey conducted around the world suggests that most individuals do accept that climate change is real and most express at least some level of concern about it (Nisbet and Myers, 2007; Reser and Swim, 2011; Brechin and Bhandari, 2011; Leviston and Walker, 2012). How can this concern and behavioral predisposition to act in a prosocial nature be effectively harnessed to effectively encourage consumers to voluntarily adopt MPs? (Etzioni, 1999, 2004; Thøgersen, 2006).

A major issue in this regard is the so-called climate 'value-action' gap: a ubiquitous phenomenon where people express concern about the environment but often display little commitment to change their own behavior accordingly (Barr, 2006; Flynn et al., 2009). This gap is seen as an important behavioral barrier to climate change adaption (Gifford, 2011; Productivity Commission, 2013; Markowitz and Shariff, 2012).

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We argue the existence of the climate value-gap can be seen as a learning problem, in the sense that learning is a process of behavior adapting to a changing environment, which individuals may have as they lack the pecuniary resources, know-how or self-confidence to align their consumer lifestyles with their stated concern about climate change (Barr, 2006; Gifford, 2011; Chai et al., 2015). Factors that have been posited to inhibit learning and contribute to the locked-in nature of current consumption patterns include: pre-existing technology and anti-environmental social norms (Lintott, 1998; Røpke, 1999; Sanne, 2002; Myers and Kent, 2003; Steinhilber et al., 2013), individual habits (Maréchal, 2010), basic ignorance (Brown and Cameron, 2000; Gifford, 2011), status concerns (Frank, 2001), rising affluence, lack of discretionary time (Chai et al., 2015) and tragedy of the common scenarios (Wagner, 2006).

One important factor that can shape the consumer learning process is the social environment through which consumers can learn new behaviors by imitating others (Bandura, 1977; Richerson and Boyd, 1998; Babutsidze, 2012; Babutsidze and Cowan, 2014). Many argue that social norms and imitation processes have real potential to help in the diffusion of pro-environmental behavior (Janssen and Jager, 2002; Welsch and Kühling, 2009; Schwarz and Ernst, 2009). Modelling also suggests that consumers could adopt environmentally friendly goods even when these goods are relatively more expensive and less hedonistically attractive to other goods (Buenstorf and Cordes, 2008; Cordes and Schwesinger, 2014). From this perspective, the tendency to imitate others could be idealistically interpreted as part of a adaptation process through which consumers learn to act in a manner that is in line with their underlying concern about climate change. This study empirically investigates this issue by shedding new light on the manner in which agents learn and imitate the green behavior of their peers. We define 'peers' as other people that respondents may observe and interact with in their local region. Using Australian data on climate change perceptions and mitigation behavior (Reser et al., 2012), we seek empirical evidence for the existence of a peer imitation process and further examine what underlying motives may drive this imitation process.

Beyond the possibility that the imitation of green behavior is driven by the individual's concern about climate change, another possibility is that imitation behavior may also be driven by a wish to attain social status among peers. Status-seeking is often perceived as a wasteful aspect of modern consumer culture (Veblen, 1899; Frank, 2001; Tilman, 1999; Woersdorfer, 2010). However, a number of recent studies argue that this tendency can be harnessed to promote pro-environmental behavior (i.e. Griskevicius et al., 2010; Mazar and Zhong, 2010; Sexton and Sexton, 2014; Brick et al., 2017). Here it is worth noting that there are potential downsides to harnessing status-seeking behavior in order to encourage the adoption of MPs. Firstly, these changes may not be permanent and could be reversed (Thøgersen and Crompton, 2009). If consumers adopt MPs as a way of signaling to others, then future changes in their role models or the messages they are exposed to in their social environment could reverse such behavior in the future (Janssen and Jager, 2002). Moreover, status-driven imitation behavior could also grow the value-action gap, in the sense that consumers could adopt a level of MPs that is disproportional to the level of underlying concern they have about climate change. Ultimately, the value-action gap is overcome when people act on their climate change concerns such that those who are very concerned about climate change are more proactive than those who are not concerned about climate change (usually a small minority).

Building on a previous study (Chai et al., 2015), this paper empirically investigates the extent to which the observation of green behavior by peers in the local environment can transform the character of consumer lifestyles and what impact it has on the climate value-action gap. Whereas the previous study considered how time, household income and the individual learning process influenced the size of the value-action gap, it did not consider the possibility that the value-action gap may be influenced by the behavior of peers in the local environment and their propensity to adopt green behaviors. Therefore, examining the expressed concern about change and the adoption patterns of 15 different visible and non-visible MPs, we use a discrete choice model to explore how peer behavior in local regions may trigger consumption 'spillovers' – i.e. changes in a range of other consumption domains (Thøgersen, 1999; Thøgersen and Ölander, 2003). We also explore whether the imitation process is driven by intrinsic motivations or status concerns by considering the extent to which these consumption spillovers are limited to the adoption of certain types of MPs that are visible to peers or whether they trigger the adoption of both visible and non-visible MPs.

This paper is structured as follows. Section 2.1 briefly reviews the evolutionary origins of social norms and how imitation behavior may be driven by various behavioral processes, including social observational learning and social signalling behavior. Section 2 discusses the data and the methodology for testing the hypotheses. Section 3 reports the results, while Section 4 provides a discussion and the policy implications. Section 5 concludes.

2. Material and Methods

2.1. Theoretical Context and Hypotheses

We investigate three related questions: First, do people imitate the green behavior of others in their local neighbourhood? Second, if they do, what type of imitation process best accounts for the observed characteristics of the imitation patterns? Third, what impact does this process have the observed climate value-action gap? In the following we define 'imitation' as the general behavioral tendency for agents to adopt MPs after observing peers adopt MPs in their local environment. The underlying principle here is simple: What type of actions I take is influenced by the observed actions taken by others. Due to the likely presence of spillover effects discussed in detail below, we do not define imitation as being the adoption of precisely the same type of MP as observed in their local environment. This is because individual differences in lifestyles, consumption knowledge and constraints that could result in heterogeneity in the manner in which agents imitate the observed green behavior by peers.

The general tendency for people to imitate others and follow social norms – rules of behavior considered acceptable by others – is considered to be a fundamental aspect of human culture that can both hinder or help ongoing efforts to achieve sustainability (Røpke, 1999; Sanne, 2002; Kinzig et al., 2013). It reflects the pro-social nature of humans that is found to play an important role and ranges from experimental one shot games (Fehr et al., 2002; Henrich et al., 2006) to altruistic behavior in the form of anonymous gift giving (Burnham, 2003).[1] Given this evidence, we argue that the tendency to adopt MPs is likely influenced by how many of their peers in the local regions also adopt MPs. As a result, we hypothesize that there is a tendency for people living in the same region to adopt a similar number of mitigation practices (Hypothesis 1). In other words, social norms relating to pro-environmental behavior emerge on the regional level and may vary significantly across regions.

Research suggests that certain conditions are important to foster the emergence and diffusion of pro-environmental norms. The first is the frequency of observing the green behavior of others in the local area. The more peers engage in visible green behavior, the more likely it is that an agent living in the same area will imitate such behavior (Biel and Thøgersen, 2007). Beyond whether or not peers adopt MPs, another contributing factor is the probability of interacting with peers in the first place (Boyd and Richerson, 1988; Janssen and Jager, 2002) –

[1] Although pervasive, attempts to effectively appeal to this pro-social nature via environmental social marketing campaigns is difficult (Lorenzoni et al., 2007; Corner and Randall, 2011).

regions with smaller peer groups are likely to produce fewer chances of observing the green behavior of peers. Moreover, there are also various competing theories about precisely what types of peers agents tend to imitate. Possibilities include experts (Earl and Potts, 2004), the well-connected (Babutsidze and Cowan, 2014) or the wealthy (Veblen, 1899). While such nuances are difficult to track empirically, in this study we do examine whether the number of peers in the same age cohort within the local region influence the agent's propensity to adopt MPs. This is consistent with the notion that agents tend to imitate those peers who are of the same age, which has found support in studies of social observational learning patterns among the youth (Brody and Stoneman, 1981; Wood et al., 2012). Other findings suggest that social sanctioning – whether individuals receive feedback from their social environment about their behavior – is also important (Axelrod, 1986; Fehr et al., 2002). In this sense, repeated interactions with the same peers could be another important condition for social imitation. This would imply that imitation is less likely to occur in regions where urban density is lower, which inhibits the chances of repeated interactions. Taken together, this literature suggests that the adoption of MPs is positively correlated with the average number of mitigation practices adopted by neighbours and the number of peers in the region (Hypothesis 2A). Imitation is less likely to occur in regions that have a low number of peers, low urban density or where only a small number of peers engage in green behavior. In this way, the adoption of green behavior is essentially frequency dependent and influenced by the size and characteristics of a region's social environment.

A deeper question is what motivates peer imitation behavior. On the one hand, imitation could be driven by an intrinsically motivated learning process in which individuals seek to adopt a consumption behavior that is aligned with their fundamental concern about climate change. As mentioned above, considerable evidence suggests that most people have a deep concern about the impact of climate change on society and their own well-being (e.g. Nisbet and Myers, 2007). Through observing role models and adopting their behavior, agents can learn about actions, skills and solutions from others even in the absence of direct verbal communication (Boyd and Richerson, 1988; Buenstorf and Cordes, 2008; Cordes and Schwesinger, 2014). Given the limited amount of cognitive resources and a range of goals, individuals save time and cognitive resources by copying from other's solutions to shared problems (Bandura, 1977; Bikhchandani et al., 1992). This ability to learn from others is thought to play an important role in human phylogeny, where natural selection favours social learners who are able to evaluate potential models and copy the most successful among them, thereby saving the costs of individual learning (Rogers, 1983; Boyd and Richerson, 1988; Henrich and Gil-White, 2001).

Alternatively, imitation can also be driven by extrinsic incentives such as social recognition. A good example is the “Prius Halo”: US consumers appear to possess a higher willingness to pay for the Toyota Prius over other, less conspicuous hybrid cars such as the Honda Civic Hybrid because it is a relatively clear and unique symbol of the consumer's environmental attitudes (Sexton and Sexton, 2014). This underlines the possibility that, in the right settings, concerned consumers may be willing to undertake costly actions in order to signal their “green” credentials to others. In contrast, other studies suggest that the consumer willingness to pay for environmental social status is relatively limited (Delgado et al., 2015; Brooks and Wilson, 2015).

While status-driven imitation behavior is still a type of learning pattern in the sense that behavior is modified in response to external stimuli (McFarland, 1987), there are important differences between imitation driven by intrinsic motives and imitation-as-signalling. In particular, differences are likely to emerge in terms of what type of consumption domains are influenced by imitation and whether imitation can trigger consumption spillovers. A spillover is usually defined as a case where a change in one domain can trigger changes in other consumption domains that are also part of the consumer's lifestyle (Thøgersen, 1999; Thøgersen and Ölander, 2003; Thøgersen and Crompton, 2009; Dolan and Galizzi, 2015). For example, Thøgersen and Ölander (2003) examined 17 different environmentally friendly behaviors among Danish consumers and found that those who recycled at one time point tended to increase their purchase of organic food products in future time periods.[2] This evidence for spillovers suggests it is vital to consider how the imitation process can play out across a number of consumption domains.

In this study, we modify this by considering how the observation of peer behavior in one consumption domain may trigger change in agent behavior in other consumption domains. Indeed there are many theoretical reasons why the imitation of peer behavior may involve spillovers. Theory suggests that the character of spillover effects is determined by how consumers learn and build complementarities across choice sets in different consumption domains (Thøgersen and Ölander, 2003; Truelove et al., 2014). Peter Earl (1986) argues that consumers are likely to follow consumption routines by building complementarities between goods and habits across different domains as a means to live out a particular individual and social identity. These complementarities form a lifestyle that suggests that there are important interconnections between seemingly unrelated consumption domains. The presence of complementarities across consumption domains suggests that social imitation and could provide the impetus for consumers to revisit and update their wider lifestyles (Chai et al., 2007). For example, observing a neighbour buying organic food in the supermarket may not trigger an individual to engage in precisely the same behavior since it may not fit with her pre-existing set of routines, knowledge and habits. Nevertheless, it may act as a cue that triggers the consumer to consider what alternative MPs could fit into her lifestyle. As such, across a population of consumer with varying lifestyles, once could expect a variation in the manner in which each agent imitates the observed green behavior of peers. The presence of such spillovers thus suggests that it is important to examine evidence for imitation processes in terms of the overall number of mitigation practices adopted by individuals located in the same region, rather than examining the tendency for consumers to adopt precisely the same type of consumption practices as their peers.

In the case where imitation is driven by intrinsic motives, it is likely that the observation of green behavior within a local region could trigger spillovers across a wide range of consumption domains, regardless of whether they are visible to others (Hypothesis 2B). Spillovers in this instance are likely shaped by the nature of the individual learning process in terms of the level of concern consumers have about climate change, the manner in which individual knowledge and skills are distributed across different domains, as well as their accumulated consumption habits that shape how consumers respond to new information and prioritize their actions (Maréchal, 2010; Witt, 2001; Witt, 2011).

Moreover, we argue that the character of spillovers will be distinct if imitation is driven by status signalling (Hypothesis 2C). A key consideration in this instance would be how visible their behavior is to their peers and the extent to which such action delivers social recognition to the individual. MPs that are not visible to neighbours, such as those conducted inside the home, are less useful for these purposes. On the other hand, MPs that are likely to be noticed by peers are more likely to be adopted. As a result, given data about the type of MPs that consumers adopt, it is possible to uncover empirical evidence about what type of processes drive imitation patterns by examining the extent to which spillovers trigger the adoption of visible MPs in comparison to the adoption of non-visible MPs.

Beyond these spillovers, to what extent can learning from peers help consumers overcome the value-action gap? Irrespective of why

[2] At the same time, not all spillovers are positive as the tendency to act green in one area can encourage consumers to act in an anti-environmental fashion in other areas (Meijers et al., 2015; Tiefenbeck et al., 2013).

imitation occurs, this process will likely impact the alignment between the individual's own stated environmental concerns and the propensity to act in an environmentally friendly way. Building on a previous study (Chai et al., 2015), we devise an empirical measure of the value-action gap that examines the difference between people's expressed climate change concerns and their propensity to adopt MPs. The gap is at a minimum when consumers who are strongly concerned about climate change tend to act on those concerns while others who express a low concern about climate change do little to act on their concerns. A larger cohort of peers could influence consumers to develop preferences that are in line with their environmental concerns, thereby reducing the size of the observed value-action gap (Hypothesis 3).

However, it could also be theoretically possible that the gap can grow if peer group pressure 'forces' people to engage in visible actions (Ockwell et al., 2009), rather than out of the individual's own expressed concern about climate change. Therefore, social peer influences could theoretically lead to a larger value-action gap if individuals who are not concerned about the environment engage in a great number of MPs in order to conform to social norms and avoid social sanctioning. As such, any evidence for Hypothesis 3 that states there is a negative association between the value-action gap and the size of the local peer cohort would essentially imply that social influences have an asymmetric effect on the population as only those individuals who are deeply concerned about climate change will tend to be influenced by the pro-environmental behavior of others in their neighbourhood. On the other hand, those who are not concerned about climate change, may not take notice of the pro-environmental behavior of others as agents may pay little attention to issues that they are not concerned about (Witt, 2011).

Hypothesis 1. There is tendency for people living in the same neighbourhood to adopt a similar number of mitigation practices.

Hypothesis 2A. The likelihood that individuals adopt MPs is positively associated with the average number of MPs adopted by peers, as well as the number of peers located in the same region.

Hypothesis 2B. If imitation is intrinsically motivated, the observation of the pro-environmental behavior of peers in the local area will be positively associated with the adoption of a wide range of MPs, regardless of whether the MPs are visible to others or not.

Hypothesis 2C. If imitation is driven by social signalling, the pro-environmental behavior of peers in the local area will be positively associated with the adoption of visible MPs only, while it will have no effect on the adoption of non-visible consumption practices.

Hypothesis 3. The greater the number of peers within a region, the greater is the propensity for people to act on their concerns and the smaller is the value-action gap.

2.2. Data

An anonymous, online web-based survey consisting of 120 items related to climate change knowledge, experiences, attitudes, concerns, and sustainable consumption practices was conducted across all states of Australia in mid-2010 (Reser et al., 2012). A professional survey firm (Qualtrics) was employed to randomly select a gender-balanced cohort of panel members residing in each of 35 geographical regions. The final sample comprised 3096 Australian citizens (47% male, 53% female) over the age of 15 years. Approximately 80% of the sample was aged from 25 to 65 years. Geographically, 71% of respondents described their residential circumstances as either urban or suburban, a further 17% as 'country town', and 12% as rural or rural residential. In terms of annual household pre-tax income, approximately half of the sample reported incomes between AUD40,000 and 100,000 (approximately USD37,800 to 94,300), with approximately one quarter reporting more, and another quarter reporting less, than this range.

The geographical distribution of the sampling procedure and ultimate survey sample reflected, in part, the nature of survey panels used by international research survey companies such as Qualtrics. Smaller centers were less likely to have resident panel members, whereas larger towns and cities had much larger numbers of available panel members. Given the largely urban population and coastal demographic distribution of settlements in Australia, the geographical distribution figures are not surprising and closely reflect national figures (ABS, 2011).

As the data was collected via an online survey, it is worth considering how accurate this data is compared to traditional survey approaches involving face-to-face interviews and telephone surveys. In this regard, a substantial review of the literature has examined the relative strengths and merits of traditional survey administration methodologies compared with online surveys, with the strong consensus being that well designed and executed web-based surveys typically achieve very comparable if not superior results to conventional best practice (e.g., Birnbaum, 2004; Chang and Krosnick, 2009; Rao et al., 2010). A common concern is that respondents tend to spend little time. Here it is worth noting that the respondents were financially compensated for their time.

Concern about climate change (c_i) was measured using the question "how concerned, if at all, are you about climate change?" Responses were on a 5-point scale from "Not at all Concerned" to "Very Concerned". This item has particular face validity, is transparent and meaningful to respondents, and appears close to the beginning of the survey, limiting the influence of further items and issues. The wording also does not presume concern, and response options allow for the selection of "don't know" or "no opinion". Results indicated that respondents were, on the whole, appreciably concerned about climate change, with 66.3% of respondents giving a "very concerned" or a "fairly concerned" rating response.

Greenhouse gas mitigation practices (m_i) were recorded via 15 questions with regard to greenness of their consumption behavior and are shown in Table 1. Respondents had to indicate if they engaged in

Table 1
Sustainable consumption practices.

Survey Question: A person's "carbon footprint" is the amount of greenhouse gases put out as a result of his or her energy use. This includes energy used directly, like electricity and fuel, as well as the energy it takes to make and transport all the products you use. What actions are you currently taking to reduce your carbon footprint? (Please tick any that apply)

Behavior	% of respondents	Visible
Recycling	88.2	Yes
Using compact florescent light bulbs	82.8	No
Using less water	79.7	No
Using less electricity	79.2	No
Driving less	48.4	No
Using less petrol	48.4	No
Walking/bicycling/scootering	40.3	Yes
Buying local food/organic food/ growing own food	39.9	Yes
Buying/using smaller/more fuel efficient car	34.0	Yes
Using trains/buses/subways/other public transport	25.9	Yes
Reducing travel/vacation travel	24.1	No
Buying energy from renewable sources	17.9	No
Reducing air travel	17.8	No
Carpooling	9.8	Yes
Buying carbon offsets	5.8	No
Nothing	2.8	No
Other	3.9	No

Note: Most of the behavior variables correlated in the low to moderate range, the highest being between "driving less" and "using less petrol" ($r = 0.67$). The question asked was "What actions are you currently taking to reduce your carbon footprint?".

each of these behaviors or not (values of 1 or 0, respectively). There are 15 possible actions that consumers can take to reduce their footprint. Note that some of these appear to be related to each other. For example, one could expect "reducing vacation travel" to be highly correlated with "reducing air travel". To check for multicollinearity, we examined the correlation coefficients between these actions. Contrary to our expectations, correlations between most actions were relatively low, the highest being (0.67) between driving less and using less petrol.

These actions were categorized as being either visible or non-visible actions. This was based on whether the activity or action is completed in the public domain. Actions that are conducted in a public domain include "using public transport", "buying smaller/more fuel efficient cars", "walking/bicycling and scootering". "Recycling" is also included on this basis as 240 l wheelie bins are typically used by most Australian consumers. Their use is observable as people are required to place these on the curb-side outside their houses on particular days when the recycling material is due to be collected. MPs deemed to be less observable include any which involved using less of a resource, such as using less electricity, driving less, reducing air travel, reducing travel. This is because it is unlikely that casual observers will perceive marginal reductions in such resources. Previous studies of visibility provide some evidence supporting these criteria. Heffetz (2011, 2012) conducted a telephone survey of US respondents about what type of expenditures they considered to be visible in their local neighbourhood. Findings suggested car expenditure to be highly visible (ranked 2 out of 31), while food expenditure was moderately visible (ranked 14 out of 31). Research by Sunitiyoso et al. (2011) into the visibility of public transport found social effects were present when people made decisions about using it in their area.

Table 2 presents the descriptive statistics of visible MPs, non-visible MPs and all MPs combined. The mean of the action variable is 6.4, which indicates that on average consumers perform less than half of the green actions (recall the maximum number of actions was 15). It is noteworthy to compare the mean values across visible and non-visible actions. Out of the 6 available visible actions, the average respondent adopted 2.4, which comprised 47%. Out of the 9 available non-visible actions the average consumer adopted 4.1, which amounted to 46%. These percentage values indicate that there appears to be little difference in terms of the propensity for consumers to engage in visible versus non-visible MPs.

Table 2
Descriptive statistics for key variables.

Variable	Nr of observations	Mean	Standard deviation	Min	Max
All actions	3014	6.4	2.9	0	15
Visible	3014	2.4	1.3	0	6
Non-visible	3014	4.1	2.0	0	9
Visible peer action (two-digit)	3012	2.4	0.3	1	5
Visible peer action (three-digit)	2968	2.4	0.4	1	5.5
Local cohort size	2443	193,923	207,637	446	639,441

Note: Descriptive statistics for other variables used in the analysis can be found in Reser et al. (2012).

Table 3
Distribution of respondents across regions.

Three-digit level		Two-digit level	
Nr of respondents	Nr of neighbourhoods	Nr of respondents	Nr of neighbourhoods
1–5	107	1–10	17
6–10	41	11–20	11
11–20	56	21–50	3
21–40	35	51–100	7
41–60	7	101–150	9
> 60	4	> 150	6
Total	250	Total	53

2.3. Methodology for Hypothesis 1

We examine Hypothesis 1 by grouping respondents according to their postcode.[3] This was done on a three and two digit level.[4] A total of 250 neighbourhoods were created on the three digit level, while 53 were created on the two digit level.[5] Table 3 presents the count of neighbourhoods in three- and two-digit aggregation levels and gives a sense of the how their sizes are distributed. On the three-digit level, the average respondents per neighbourhood are 12.1 with 52 neighbourhoods having only one respondent (meaning a size of 1). On the two digit level, the average number of respondents per neighbourhood was 56.9 and there are only two neighbourhoods with a single respondent (33 and 85).

Analysis of variance (ANOVA) is used to explore whether there is a tendency for people to adopt the same number of MPs within geographical neighbourhoods. ANOVA calculates the likelihood of observing similar behavior between a pair of consumers from the same neighbourhood and contrasts this to the similarity of a pair of consumers from different neighbourhoods. This decomposes the variance of a variable into between-group and within-group parts. If the variance between groups is significantly higher than the variance within groups, then this counts as evidence for Hypothesis 1. This would correspond to geographical clustering in behavior. ANOVA is essentially an F-test comparing the similarity of variable between two pairs of randomly drawn observations: one pair is drawn from the same neighbourhood, the other pair is drawn from two different neighbourhoods. The null hypothesis is that there is no difference across the two pairs.[6] The alternative hypothesis is that there is a statistically significant difference that the pair of observations drawn from the same neighbourhood are closer in value to each other than the pair of observations drawn across two different neighbourhoods.

In addition, we also check the extent to which there is homogeneity in the type of MPs adopted within the same region. As discussed in the previous section, we expect the set of MPs to be different across individuals, although the overall number of MPs adopted is similar across consumers in the same region. If consumers in the same region did adopt very similar types of MPs, this could suggest that other factors are responsible for our results. For example, if certain MPs, such as public transport, where relatively cheaper in some regions then one would expect consumption profiles in these regions to be more homogenous, which could account for the ANOVA results. Therefore, we checked how much variation there was in the type of MPs adopted by consumers in the same region. For a given aggregate variable, the consumption

[3] An alternative aggregation strategy is to aggregate respondents by stated region. We use this in a robustness check discussed in Section 3.2. Beyond grouping respondents according to region, it would be ideal to further group them according to age cohort. However this is not possible due to ratio of observations to regions. For this reason, the robustness check also features a study of how the size of the age cohort within each region influences the adoption of MPs and the value action gap (see Table 7 and Table 8).

[4] Several other studies have used two digit postcode aggregation strategies to study regional correlations in Australia, i.e. Karmel and Rosman (2008).

[5] Australian postcodes range from 0200 for the Australian National University (now 2601) to 9944 for Cannonvale, Queensland. While the first number of a postcode usually indicates the state or territory, the second number usually indicates a region within the state. Postcodes with higher second numbers are usually located in rural and regional areas. PO Box and Business numbers have been excluded from the analysis.

[6] Analysis of variance assumes that the within-neighbourhood variance of the variable is constant across the neighbourhoods. To check the validity of this assumption in our data we performed Bartlett's Chi-squared test, for which the null hypothesis is the equality of variances across all neighbourhoods.

profile can be represented by a string of binary values of a certain length indicating a consumer's engagement in green behavior $P^i = \{c_1{}^i, c_2{}^i, \ldots, c_k{}^i\}$, where $c_m{}^i$ takes binary values. It is equal to 1 if consumer i has taken action m, and 0 if he/she has not. The length of the string is denoted by k. For the visible MPs, $k = 6$ (as there are 6 visible MPs), while for non-visible consumption $k = 9$. For the variable combining all 15 MPs $k = 15$. Using this representation, we can calculate the Euclidean distance between any two consumption profiles (i and j) using:

$$E^{ij} = \sum_{m=1}^{k} \left| c_m^i - c_m^j \right|.$$

If two consumers behave the same way with regard to an action, the contribution to the Euclidean distance will be zero. However, if they behave differently, the contribution will be equal to one. Thus, the Euclidean distance across two consumption profiles will return a value between 0 and k. If the distance is zero this indicates complete similarity between two profiles, while the value of k indicates complete dissimilarity. In order to be able to compare the values across different aggregate variables (visible, non-visible and aggregate), we normalize Euclidean distances by k ($e^{ij} = E^{ij}/k$), which results in a measure confined to the interval $[0, 1]$ in all cases. Based on such a measure, we can calculate the neighbourhood-specific profile dispersion by averaging normalized Euclidean distances across all possible pair combinations. Doing this at the two-digit aggregation level results in neighbourhood-specific measures for 198 neighbourhoods.

2.4. Methodology for Hypothesis 2

A discrete choice model of the consumer's propensity to engage in both visible and non-visible consumption practices is used to examine Hypothesis 2. Specifically, a Poisson count model (Train, 2009) is a standard type of model to examine the number of visible and non-visible MPs undertaken by the consumer (the dependent variable). However, the standard Poisson model imposes the restriction of mean and variance equality of the dependent variable. We conducted a Nyman-Scott test for mean-variance equality (Brown and Zhao, 2002). This points to the under-inflation (mean > variance) of one of the two dependent variables. Hence, we switched to using a generalized Poisson specification proposed by Consul and Famoye (1992) to estimate our model. Generalized Poisson delivers estimates equal to those from Poisson regression if the dependent variable follows a Poisson distribution and consistent estimates in case of over-inflation or under-inflation of the variable (Harris et al., 2012).

In terms of explanatory variables, we are interested in understanding how a consumer's green actions are affected by peer behavior. Using the definition of neighbourhood discussed above, three sets of neighbourhood scores are constructed for visible action, non-visible action and all actions for each consumer:

$$S_j^i = \frac{1}{n_j - 1} \sum X_j^{-i}$$

Where $S_j{}^i$ is the type of neighbourhood score (for visible, non-visible and total action) for each consumer i in each neighbourhood j. The score represents the simple average of the number of relevant actions (visible, non-visible and all actions) taken by peers. This score is unique to each respondent as the individual's own action is excluded from the calculation. The higher the score, the greater is the average number of actions undertaken by peers located in the same region.[7]

Control variables cover a wide range of factors thought to contribute to both the level of concern and the propensity to engage in sustainable consumption practices:

i. Climate response variables include a variable designed to capture the individuals' objective knowledge of climate change, as well as one that approximates their belief in/acceptance of climate change. The former is a composite indicator that was built from responses to a series of true/false responses to facts about climate change that are designed to gauge how much individuals know about climate change (see Appendix J in Reser et al., 2012). Statements included "Globally, the current burning of fossil fuels accounts for 80-85% (CO2) emissions added to the atmosphere". The latter was also a composite indicator that was built from responses asking individuals about the extent to which they agree with statements such as "I am certain climate change is happening" and "As far as you know, do you personally think the world's climate is changing, or not?".
ii. Social influence includes the number of pro-environmental films/documentaries such as *"An inconvenient truth"* that the respondent has viewed (range between 0 and 15, "Media Exposure"), as well as the extent to which people discuss their thoughts and feelings about climate change with others ("discuss with peers", 5-point Likert scale). We anticipated that these factors would have a positive relationship with concern and behavior.
iii. Demographic Variables include respondents' age, gender (dummy variable), whether they have children (dummy variable), level of education, income.
iv. Climate experience variables include whether individuals have experienced a natural disaster or warning (dummy, "disaster experience"), and the frequency of experience of bad weather events such as storms and drought (5-point Likert response scale, "Freq. Weather"). We expected these factors to have a positive effect on concern and behavior.

2.5. Methodology for Hypothesis 3

In relation to the value-action gap, we normalize c_i and m_i so that they were expressed in percentage terms between 0 and 1. This was done by dividing each variable by the maximum, $C = 5$ in the case of concern and $M = 15$ in the case of mitigation behavior. The resulting two variables were positively correlated at $r = 0.385$. For each respondent, we then calculated the absolute value of the simple difference between these terms:

$$gap_i = \left| \frac{c_i}{C} - \frac{m_i}{M} \right|$$

A value of unity represents the case where the individual has strong concern for the environment, but engages in no mitigation behavior. Alternatively, unity can also be the outcome where the individual adopts all m_i, but does not care at all about climate change. In reality, a histogram of the term $\frac{c_i}{C} - \frac{m_i}{M}$ reveals that for an overwhelming majority of the population $\frac{c_i}{C} > \frac{m_i}{M}$, while only a minority (12%) possess a propensity to act that is greater than their stated level of concern. As discussed in Chai et al. (2015), the observed differences tend to be larger among those people who express the greatest concern about climate change.

In terms of explanatory variable, we develop a proxy for the imitation process in regions by calculating the number of peers located in the same region and in the same age group as any given respondent. As noted in Hypothesis 3, the greater the number of peers located in a particular region, the greater the potential for consumers to imitate and learn from peers. Data about the number of people living in the same neighbourhood and their age groups were sourced from the Australian Census (ABS, 2011).

[7] For example, consider a neighbourhood of four people: a, b, c and d. Consumer a takes 3 visible actions, b takes 6 visible actions, c takes 0 and d takes 12 visible actions. So the neighbourhood score of visible action for consumer A would be (6 + 0 + 12)/3 = 6. For agent b it is different, as he is observing the behavior of a, c and d.

3. Results

3.1. Hypothesis 1: Regional Clustering

Hypothesis 1 states there is a tendency for consumers located in the same region to engage in a similar number of m_i as their peers. The results of the ANOVA analysis are reported in Table 4. The P values indicate evidence for this Hypothesis that there is regional clustering across all m_i at the 10% level of significance (P = 0.084). However, when examining disaggregated results for visible and non-visible m_i, we find that regional clustering only appears to be present among visible m_i (P = 0.000). On the other hand, non-visible m_i do not appear to exhibit clustering (P = 0.120). This result is in line with expectations that individuals do not imitate non-visible MPs, which are harder to observe in their local environment. All in all, the results from the ANOVA analysis provides some evidence that that individuals tend to possess the same number of MPs as their neighbours, which is consistent with Hypothesis 1.

How do these results vary across Australia? Table 5 provides the results of a disaggregated analysis for each of the 6 states present in the sample: Queensland, New South Wales, Victoria, Tasmania, Western Australia, South Australia and the Northern Territory. In relation to non-visible m_i, the results consistently show that there is no evidence that consumers adopt a similar number of m_i in their region. In relation to visible m_i, results in three out of the four states support the conjecture that consumers tend to adopt a similar number of m_i as their peers. It is interesting to note that in the two states with relatively low population density, Northern Territory and Western Australia, there is no evidence for regional clustering of m_i across both visible and non-visible variants.[8] On the other hand, those states with relatively higher population density, including New South Wales, South Australia and Queensland, the ANOVA results yield evidence for clustering across both two digit and three digit postcode regions. Less consistent results were achieved for Victoria and Tasmania. These regional differences suggests that the emergence of green social norms is dependent on the presence of a minimum level of urban density which is crucial for fostering social interaction and the observation of peer behavior (discussed in Section 2).

One possible explanation for what drives regional clustering could be that some m_i are relatively cheaper in certain regions. For example, one can argue that the cost of public transport is different across regions. Urban dwellers may face cheaper prices for using public transport compared to rural inhabitants. Similarly, buying organic food could be limited in its availability in particular regions of Australia. To check whether regional price differences do account for the clustering results, we conduct the following sensitivity check. Given the diversity of regions on two-digit aggregation level, the importance of region-specific prices would imply a relatively large variance in the adoption of any one specific MP across the observed regions. We calculate such variance across regions for every of our 15 mitigation practices and normalize them by dividing by the average adoption rate across all regions. These show that there is relatively small variance in the adoption rates across regions (the average is 7%). Moreover, the top three MPs that are most likely influenced by region-specific factors are the usage of public transport, air-travel and car-pooling practice. As a sensitivity check, we examine whether the removal of these three MPs from our analysis affects our results. If our results were indeed driven by region-specific prices, dropping these MPs should eliminate the clustering results. Results are presented in the Appendix (see Table 4A). They show that findings remain unchanged.[9]

Furthermore, if differences in regional differences in the price of MPs did determine the type of m_i adopted in each region (and therefore regional clustering), we would also expect that two people living in the same region would adopt the same types of m_i. This would result in the homogeneity of observed consumption profiles within the regions. As such, sufficient variation in the types of m_i chosen by agents in the same region would serve as further evidence that our results are not driven regional differences in the prices of m_i.[10] Therefore, we calculate the variation in the type of m_i that were undertaken by two individuals living in the same region. Fig. 1 reports the Euclidian distance between consumer profiles for all (visible and non-visible) m_i at the two digit level. It shows that the dissimilarity in consumer profiles was large and stable across all regions.[11] The average measure of consumer profile heterogeneity is 0.33 when all 15 behaviors are considered. The average distance is 0.34 for visible m_i profiles and 0.33 for the non-visible m_i profiles. The results do not alter significantly if we use an

Table 4
ANOVA Results on the regional clustering of mitigation practices.

A: Three-digit aggregation

	ANOVA			Bartlett test		
	F	Total degrees of freedom	P value	χ^2	Degrees of freedom	P value
Action	1.13	3013	0.089	174.09	196	0.868
Visible	1.36	3013	0.000	166.40	188	0.870
Non-visible	1.11	3013	0.120	161.68	193	0.951

B: Two-digit aggregation

	ANOVA			Bartlett test		
	F	Total degrees of freedom	P value	χ^2	Degrees of freedom	P value
Action	1.28	3013	0.084	38.05	50	0.892
Visible	2.22	3013	0.000	39.35	50	0.861
Non-visible	1.03	3013	0.414	55.12	50	0.287

Table 5
ANOVA results for the regional breakdown.

Region	Variable	Two-digit	Three-digit	Nr of Obs.
New South Wales	Visible	Yes	Yes	668
	Non-Visible	No	No	
Victoria	Visible	No	Yes	464
	Non-Visible	No	No	
Queensland	Visible	Yes	Yes	914
	Non-Visible	No	No	
South Australia	Visible	Yes	Yes	416
	Non-Visible	No	No	
Western Australia	Visible	No	No	375
	Non-Visible	No	No	
Tasmania	Visible	Yes	No	131
	Non-Visible	No	No	
Northern Territory	Visible	No	No	46
	Non-Visible	No	No	

Note: Results in this table are from the region-specific ANOVA analysis. “Yes” means a statistically significant clustering in behavior, while “No” means no evidence for clustering in behavior.

[8] However, the low number of observations in the Northern Territory cast some doubt on the results for this region.

[9] In addition, we also checked how our results would differ if “recycling” was re-classified as a non-visible activity, instead of a visible activity. Results are presented in the Appendix (Table 4B). They confirm our results are robust.

[10] Beyond prices, there are of course a range of possible explanations that may account for why consumer profiles are homogenous within the same region. Example includes demand side fashion trends. As mentioned in the previous section, this study focuses on behavioral spillover effects which predicts both regional homogeneity in the number of MPs adopted by agents in the same region and heterogeneity in the type of MPs adopted by individuals. Homogeneity in m_i is not a requirement for the imitation process investigated in this study.

[11] Results for disaggregated categories are similar for visible and non-visible MPs. Due to space constraints, they are not included here, but they are available upon request.

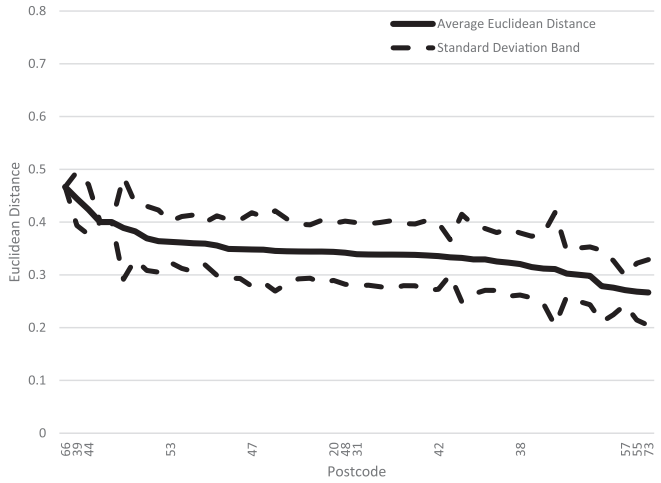

Fig. 1. Euclidean distance between consumer profiles across two-digit neighbourhoods.

average weighted by the neighbourhood size instead of the simple average over neighbourhoods.[12] These results indicate that there is a considerable heterogeneity in consumption profiles within neighbourhoods.[13] In other words, they suggest that there is low likelihood that two consumers located in the same region engage in the same type of MPs. This counts as evidence against difference in the relative prices of MPs accounting for the ANOVA results, since if cheaper MPs in some regions drove our results, we would expect the m_i profiles to be homogenous in the sense that all agents in the same region would be adopting the same (relatively cheap) m_i in their region.

Note the value of this measure is strongly influenced by the measure of the intensity of activities. For example, the mean of the "All actions" variable is 6.4, which means that, on average, consumers take 6.4 m_i out of 15. Then, if we consider a pair of consumers, the most diverse profile they can have is to have been choosing completely orthogonal 6.4 actions. However, even in this case, the measure of normalized Euclidean distance cannot attain 1, it will be 0.853. This is because the average number of actions taken is lower than half of all possible actions. Effectively, these two consumers will always have the same 2.2 actions that they have not taken. This will register as similarity of profiles.[14] Therefore, the normalized Euclidean distance constitutes the lowest boundary of similarity between consumption profiles in our dataset. All in all, this evidence supports Hypothesis 1 and suggests that in spite of considerable variation in the type of m_i adopted by consumers in the same region, there is a tendency for them to adopt a similar number of m_i as others in their region.

3.2. Hypothesis 2: Behavioral Spillovers

Results for the generalized Poisson regression modelling with the adoption of visible and non-visible m_i are reported in Table 6. Columns A and B report results where neighbourhoods were aggregated to the 2 digit level, while the columns C and D report results for the three digit level of aggregation. The dependent variable in columns A and D is the number of visible m_i, while the dependent variable in columns B and D is the number of non-visible m_i undertaken by respondents.

The results show that across both visible and non-visible m_i, the individual's knowledge of climate change and their stated concern about climate change was positively correlated with their propensity to adopt m_i. This lends some support to the notion that intrinsic concern about climate change triggers action. Furthermore, media exposure and the tendency to discuss climate issues with peer's impact both have a positive and significant correlation with the propensity to adopt m_i.[15] Results in columns A and C suggest that consumers in rural areas appear to be less likely to adopt visible m_i. This is expected given the probability of being observed by others in rural areas is low. Moreover, as a subset of the visible m_i relates to transport options, it is likely that agents who travel further may be less inclined to engage in pro-environmental options when longer distances and longer time costs are involved. Education is also positively correlated with the propensity to adopt m_i.

Income appeared to be negatively correlated with the adoption of m_i. We found the negative sign for the income coefficient somewhat curious. It was expected that high income individuals would have a greater willingness to pay for pro-environmental goods. We suspect the negative association is due to the fact that many of the m_i are not related to spending behavior. Rather, they relate to conservation actions, which require time to execute. Perhaps because many m_i require relatively more time (i.e. switching off lights, using public transport, walking) and high income consumers are relatively time poor, this could explain the negative coefficient. In Chai et al. (2015), this issue was investigated by reclassifying m_i according to whether they required more time or less time. It was found that for m_i that require little time, such as buying carbon offsets, income had a positive and significant impact on the propensity to adopt these types of m_i. On the other hand, for m_i that were time intensive, such as using public transport, income had a negative and significant impact on the propensity to adopt these types of m_i.

In terms of the main variable of interest, the parameter estimate for visible peer action is found to have a positive and significant impact on the adoption of visible m_i (see column A and C). It is positive and significant at the 99% confidence level. This suggests that the more peers located in the same region adopt visible m_i, the greater is the probability that agents will also adopt visible m_i. This evidence support Hypothesis 2A. Note that we conducted a similar test to examine whether the average number of non-visible m_i was positively correlated with the adoption of both visible and non-visible m_i. Here we found that the average number of non-visible m_i has no significant influence on the adoption of visible or non-visible m_i.[16] In other words, if the m_i adopted by the neighbour is not visible, no significant correlation is found between the neighbour's action and the adoption of visible or nonvisible m_i. This result suggests that the neighbours' behavior only has an influence on the propensity to adopt m_i if green peer behavior is visible. In terms of whether the imitation process is driven by intrinsic motives or status concerns, Table 6 shows that visible peer action appears to have no significant impact on non-visible m_i (see column B and D). As such, these results support Hypothesis 2C that the imitation process appears to be driven by status concerns. This result suggests that the behavioral tendency to imitate the green behavior of peers does not generate spillovers in other, non-visible consumption domains, as implied by Hypothesis 2B.

[12] In the case of two-digit aggregation consumption, profile diversity measures are slightly higher: 0.34 for the complete profile, 0.35 for the visible, and 0.34 for the non-visible

[13] In fact, the calculated measures underestimate this diversity. This is because our measure does not explicitly control for the fact that the rate of consumption is usually below 50% for our three composite variables. For example, the mean of the action variable is 6.4 out of a possible 15. This means that if we take two "average" consumers and compare their MP profiles, even if none of the actions are taken by either of the consumers (maximum diversity), we will still have two actions which will not be taken by either of them. Therefore, the distance that we calculate will be at most 0.87 (and not 1, which would imply complete dissimilarity across the two profiles).

[14] Note, that we would have the same problem if consumers took a large number of actions, say 10 each. In this case, we would always have at least 5 actions that would coincide across the two profiles.

[15] Since much media content features role models (Steg and Vlek, 2009), the positive and significant relationship between media exposure and the adoption of mitigation practices can represent more evidence for imitation behavior.

[16] These results are available upon request.

Table 6
Results for discrete choice modelling of behavioral spillovers.

	Three-digit aggregation				Two-digit aggregation			
	Visible (A)		Non-visible (B)		Visible (C)		Non-visible (D)	
Independent variable	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Observable neighbourhood behavior	0.062***	(0.022)	− 0.020	(0.020)	0.116***	(0.039)	− 0.030	(0.034)
Knowledge of climate change	0.018***	(0.004)	0.015***	(0.003)	0.017***	(0.004)	0.015***	(0.003)
Concern about climate change								
Not very concerned	0.219***	(0.041)	0.219***	(0.037)	0.222***	(0.041)	0.217***	(0.036)
Fairly concerned	0.317***	(0.040)	0.331***	(0.036)	0.321***	(0.039)	0.333***	(0.036)
Very concerned	0.370***	(0.042)	0.404***	(0.038)	0.375***	(0.042)	0.407***	(0.037)
Discuss with peers								
Disagree	0.148***	(0.040)	0.154***	(0.035)	0.152***	(0.039)	0.151***	(0.035)
Somewhat disagree	0.173***	(0.041)	0.160***	(0.036)	0.173***	(0.041)	0.157***	(0.036)
Somewhat agree	0.236***	(0.039)	0.220***	(0.035)	0.236***	(0.039)	0.216***	(0.034)
Agree	0.274***	(0.039)	0.276***	(0.035)	0.277***	(0.039)	0.271***	(0.034)
Strongly agree	0.328***	(0.045)	0.303***	(0.039)	0.323***	(0.044)	0.295***	(0.039)
Media exposure	0.042***	(0.006)	0.040***	(0.006)	0.042***	(0.006)	0.039***	(0.006)
Freq. weather	− 0.009	(0.015)	0.004	(0.012)	− 0.007	(0.015)	0.004	(0.012)
Disaster experience	− 0.001	(0.021)	0.001	(0.019)	0.006	(0.021)	0.004	(0.019)
Household income								
$40,001–$60,000	0.015	(0.031)	− 0.060**	(0.027)	0.012	(0.030)	− 0.060**	(0.026)
$60,001–$80,000	− 0.026	(0.033)	− 0.075***	(0.028)	− 0.029	(0.032)	− 0.074***	(0.028)
$80,001–$100,000	− 0.021	(0.034)	− 0.107***	(0.030)	− 0.027	(0.033)	− 0.103***	(0.029)
$100,001–$150,000	− 0.022	(0.033)	− 0.104***	(0.030)	− 0.021	(0.033)	− 0.098***	(0.029)
$150,001–$200,000	0.006	(0.050)	− 0.129***	(0.046)	0.008	(0.050)	− 0.125***	(0.046)
Greater than $200,000	− 0.014	(0.074)	− 0.161**	(0.069)	− 0.005	(0.074)	− 0.161**	(0.069)
Discretionary time	0.025*	(0.013)	0.036***	(0.011)	0.023*	(0.013)	0.038***	(0.011)
Age	0.001*	(0.001)	0.004***	(0.001)	0.001	(0.001)	0.004***	(0.001)
Gender	− 0.068***	(0.020)	− 0.019	(0.018)	− 0.065***	(0.020)	− 0.018	(0.018)
Education								
Year 11	0.161***	(0.053)	0.019	(0.047)	0.155***	(0.052)	0.022	(0.047)
Year 12 or equivalent	0.081**	(0.033)	0.039	(0.027)	0.076**	(0.032)	0.039	(0.027)
University degree	0.114***	(0.037)	− 0.001	(0.032)	0.106***	(0.037)	− 0.005	(0.032)
Postgraduate degree	0.172***	(0.042)	0.080**	(0.036)	0.161***	(0.041)	0.079**	(0.036)
Children	− 0.056**	(0.024)	0.002	(0.021)	− 0.055**	(0.024)	− 0.003	(0.021)
Current residence type								
Suburban	− 0.034	(0.028)	0.019	(0.026)	− 0.036	(0.028)	0.017	(0.026)
Rural	− 0.096***	(0.032)	− 0.004	(0.029)	− 0.090***	(0.032)	− 0.002	(0.029)
Constant	0.038	(0.094)	0.592***	(0.082)	− 0.085	(0.121)	0.618***	(0.106)
Observations	2717		2717		2764		2764	

Note: Results from the Generalized Poisson estimation. Dependent variable is the number of MPs adopted. Standard errors are given in brackets. Significance levels: *-90%, **-95%, ***-99%. Baseline options for categorical variables are: Concern about climate change - “Not concerned at all”, Discussion with peers - “Strongly Disagree”, Household Income - “ < $40,000”, Gender - “Female”, Education - “Less than year 11”, Residence type - “Urban”.

In order to check the robustness of these results, we used both a different geographic aggregation method as well as an alternative dependent variable. Concerning the former, we used the stated population centre instead of using postcodes to classify respondents into the same regions.[17] In relation to the alternative dependent variable, we used census data that reported the number of peers located in that region that belonged to the same age group as the respondent (ABS, 2011). For example, if the respondent is 22 years old and living in Canberra, the dependent variable is the number of 20–24 year-olds living in Canberra. This represents a major robustness test as there are salient geographical differences between the 37 regions used in this approach and the regions derived from postcode location.

Table 7 reports the results. The size of the peer cohort was found to have a positive and significant effect on m_i at the 95% confidence level. This result confirms the robustness of our findings, shown in Table 6, and suggests that individuals located in areas with a larger peer cohort have a greater propensity to adopt m_i. Examining differences across visible and non-visible m_i (columns F and G), the peer cohort size was found to be positively and significantly correlated with visible m_i, but not with non-visible m_i. This again confirms the robustness of our previous results supporting Hypothesis 2A.[18]

3.3. *Hypothesis 3: The Value-Action Gap*

Table 8 reports the impact for the model of the value-action's gap. A negative sign for parameter estimate indicates evidence that explanatory variables appear to reduce the gap between the individual's stated concern and the propensity to act. For example, results show that those respondents who possessed better knowledge of climate change tended to have a lower value-action gap, i.e. were more likely to act on their climate concerns.[19] Likewise, those individuals who discussed climate change with peers, had more discretionary time, were older and

[17] The list of stated population centers are reported in Reser et al. (2012).

[18] Interaction terms between discussion with peers and local peer cohort size were also examined to see if the former had a greater impact in locations where the peer cohort size was larger. These terms were found to be not significant.

[19] This result could be counted as evidence for intrinsically motivated learning behavior. People who are concerned about climate change may act on this concern by learning about this issue and subsequently adopting mitigation practices. However, this issue is orthogonal to focus of this study in the sense that we concentrate on whether the imitation of peers is driven by intrinsically motivated or driven by status concerns.

Table 7
Robustness test using alternative regional aggregation strategy and number of peers in the region.

	All (E)		Visible (F)		non-Visible (G)	
Independent variable	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Observable neighbourhood behavior	0.017***	(0.003)	0.018***	(0.004)	0.016***	(0.004)
Knowledge of climate change	0.269***	(0.038)	0.250***	(0.045)	0.217***	(0.040)
Concern about climate change						
Not very concerned	0.374***	(0.037)	0.332***	(0.044)	0.327***	(0.039)
Very concerned	0.448***	(0.038)	0.381***	(0.046)	0.413***	(0.041)
Discuss with peers						
Disagree	0.184***	(0.036)	0.200***	(0.045)	0.166***	(0.039)
Somewhat disagree	0.190***	(0.037)	0.215***	(0.047)	0.161***	(0.040)
Somewhat agree	0.241***	(0.036)	0.276***	(0.045)	0.213***	(0.039)
Agree	0.307***	(0.035)	0.330***	(0.045)	0.281***	(0.038)
Strongly agree	0.339***	(0.040)	0.394***	(0.051)	0.293***	(0.044)
Cohort size	0.001**	(0.000)	0.001**	(0.000)	0.000	(0.000)
Media exposure	0.039***	(0.006)	0.037***	(0.007)	0.039***	(0.006)
Freq. weather	− 0.002	(0.012)	− 0.011	(0.016)	0.000	(0.013)
Disaster experience	0.013	(0.019)	0.002	(0.024)	0.015	(0.021)
Household income						
$40,001–$60,000	− 0.034	(0.027)	0.034	(0.034)	− 0.067**	(0.030)
$60,001–$80,000	− 0.042	(0.028)	0.005	(0.037)	− 0.065**	(0.031)
$80,001–$100,000	− 0.087***	(0.030)	− 0.023	(0.037)	− 0.110***	(0.033)
$100,001–$150,000	− 0.055*	(0.029)	0.001	(0.037)	− 0.087***	(0.032)
$150,001–$200,000	− 0.092**	(0.046)	− 0.001	(0.056)	− 0.116**	(0.051)
Greater than $200,000	− 0.085	(0.066)	0.028	(0.081)	− 0.153**	(0.075)
Discretionary time	0.035***	(0.011)	0.029**	(0.014)	0.038***	(0.012)
Age	0.004***	(0.001)	0.001	(0.001)	0.005***	(0.001)
Gender	− 0.042**	(0.018)	− 0.063***	(0.023)	− 0.019	(0.020)
Education						
Year 11	0.056	(0.049)	0.131**	(0.061)	0.017	(0.054)
Year 12 or equivalent	0.059**	(0.028)	0.082**	(0.036)	0.038	(0.030)
University degree	0.036	(0.032)	0.112***	(0.041)	− 0.014	(0.035)
Postgraduate degree	0.113***	(0.036)	0.174***	(0.045)	0.074*	(0.039)
Children	− 0.025	(0.021)	− 0.053**	(0.027)	− 0.003	(0.023)
Current residence type						
Suburban	0.016	(0.025)	− 0.024	(0.031)	0.039	(0.028)
Rural	0.005	(0.030)	− 0.057	(0.037)	0.041	(0.033)
Constant	0.934***	(0.070)	0.078	(0.089)	0.482***	(0.076)
Observations	2244		2244		2244	

Note: Results from the Generalized Poisson estimation. Dependent variable is the number of MPs adopted. Standard errors are given in brackets. Significance levels: *-90%, **-95%, ***-99%. Baseline options for categorical variables are: Concern about climate change - “Not concerned at all”, Discussion with peers - “Strongly Disagree”, Household Income - “< $40,000”, Gender - “Female”, Education - “Less than year 11”, Residence type - “Urban”.

tended to exhibit a relatively lower value-action gap.

Hypothesis 3 argues that social learning could assist consumers to learn how to act on their climate change concerns. This is confirmed as the parameter estimate for peer cohort size was found to be significant at the 95% confidence level and possessed a negative sign. Though the size of the impact is small, this suggests that, on the whole, the influence of peers tends to help individuals achieve greater alignment between their expressed concern about climate change and their propensity to act.

Further tests were conducted to check whether there were any significant differences among the smaller subgroup of respondents who tended to engage in a greater number of MPs, but expressed a low level of concern about climate change. The majority of respondents (2419 observations – 87% of the sample) expressed a level of concern about climate change that was far greater than their propensity to act. After running the regression for this larger subgroup, the size of the parameter estimate for peer cohort size was found to increase. On the other hand, for the small group of individual who expressed very little concern about climate change but engaged in many m_i (246 observations), the size of the peer groups has no significant impact on their value-action gap. This suggests that the social learning effect is limited to the subpopulation of individuals who express a strong concern about climate change. This lends evidence to the notion that those who are not concerned about climate change may not tend to notice of green behavior of peers as they tend to ignore information and cues about issues that they are not concerned about (Witt, 2001).

4. Discussion

Taken together, our results highlight both the power and limitations that social learning patterns can have in stimulating pro-environmental changes in consumption patterns. On the one hand, the results provide evidence that there is a propensity for agents to engage in a similar number of MPs as their neighbours, even though there is a large degree of variation in the specific type of MPs adopted by agents located in the same region. While there exist a range of potential reasons that could account for this result, we strongly suspect this clustering is caused by the existence of environmental social norms within regions. Our results support this explanation by showing there exist a positive and significant correlations between the agent's propensity to adopt visible mitigation practices and the average number of visible MPs adopted by peers located in the same region, as well as the size of the peer cohort in the region. In addition, the tendency for consumers to adopt a similar number of mitigation practices appears to be stronger in those states that are more densely populated. We also find evidence that the greater is the size of peer cohort within a region, the smaller is the observed value-action gap. This suggests that social learning helps agent's achieve consumer lifestyles that are more aligned with their concern for climate change.

In terms of producing effective pro-environmental social marketing campaigns, these results suggest that it is critical to account for the structure of the local social environment and the level of peer interactions found within particular regions. Rather than spending more

Table 8
Results of the climate value-action gap.

Independent variable	Coefficient	S.E.
Knowledge of climate change	−0.005***	(0.001)
Concern about climate change		
Not very concerned	0.020*	(0.012)
Fairly concerned	0.176***	(0.011)
Very concerned	0.371***	(0.012)
Discuss with peers		
Disagree	−0.017	(0.012)
Somewhat disagree	−0.038***	(0.012)
Somewhat agree	−0.041***	(0.012)
Agree	−0.080***	(0.012)
Strongly agree	−0.099***	(0.014)
Cohort size	−0.001**	(0.000)
Media Exposure	−0.012***	(0.002)
Freq. Weather	−0.003	(0.005)
Disaster experience	−0.005	(0.007)
Household income		
$40,001–$60,000	0.027***	(0.010)
$60,001–$80,000	0.021**	(0.010)
$80,001–$100,000	0.036***	(0.011)
$100,001–$150,000	0.012	(0.011)
$150,001–$200,000	0.046***	(0.016)
Greater than $200,000	0.028	(0.024)
Discretionary time	−0.006	(0.004)
Age	−0.001***	(0.000)
Gender	0.013**	(0.007)
Education		
Year 11	0.001	(0.018)
Year 12 or equivalent	−0.016	(0.010)
University degree	−0.008	(0.011)
Postgraduate degree	−0.029**	(0.013)
Children	0.011	(0.008)
Current residence type		
Suburban	−0.006	(0.009)
Rural	−0.013	(0.011)
Constant	0.284***	(0.024)
Observations	2244	

Note: Results from Tobit estimation, upper limit = 1, lower limit = 0. Dependent variable is the value-action gap. Standard errors are given in brackets. Significance levels: *-90%, **-95%, ***-99%. Baseline options for categorical variables are: Concern about climate change - “Not concerned at all”, Discussion with peers - “Strongly Disagree”, Household Income - “<$40,000”, Gender - “Female”, Education - “Less than year 11”, Residence type - “Urban”.

resources to directly inform and educate consumers through the mass media, policymakers may wish to consider creating more grass roots-orientated campaigns that target regional norms featuring local events and platforms through which concerned citizens can interact and better observe pro-environmental behavior of their peers (Nyborg et al., 2006; Ockwell et al., 2009; McKenzie-Mohr, 2013).

Moreover, our results also suggest that an important feature of this imitation process is that consumers may respond in a heterogeneous fashion to observing pro-environmental behavior. Instead of adopting the same type of MPs observed in the local environment, they may respond by adopting other MPs that better suit their lifestyle and skills. For example, if neighbours drive smaller, fuel efficient cars, a consumer may respond by catching public transport. Another consumer who observes the same car may choose to imitate by recycling. As such, green social norms appear to be ‘emergent’ in the sense that it is only when the overall number of MPs are compared across agents in the same region that we find evidence for imitation behavior. This approach recognizes the fact that, due to individual differences in lifestyles, the manner in which agents will respond to green behavior observed in their peers. This underlines the need for a consumer theory that can account for this heterogeneity in behavior in terms of consumer's lifestyles (Earl, 1986), social network access or learning histories (Witt, 2001). As a result, while the correlation coefficients between different pairs of MPs are low, there is nevertheless evidence that the frequency of visible MPs encourages others to adopt visible MPs. These findings also suggest a different approach to measuring the effectiveness of pro-environmental campaigns. Much of the time, the success of pro-environmental campaigns is measured in terms of the propensity for a population to adopt one particular type of MP (e.g. Corner and Randall, 2011).

These results are also relevant for the literature on green nudging (Thaler and Sunstein, 2008, Allcott, 2011, Allcott and Rogers, 2014, Sudarshan, 2014). A key idea in this literature is that enabling consumers to make social comparisons with their peers may serve to foster pro-environmental behavior. A classic example is the case of electricity bills that provide information about average electricity consumed in the local neighbourhood. In this regard, our results consistently show that certain non-observable MPs, such as using less electricity, using less water, and reducing air travel, did not respond to social influences. This could be because consumers lack a way of being able to compare their own behavior to other in these consumption domains.

Beyond the ability to make comparisons, the results also suggest that being able to signal green behavior to others is another important dimension. This involves not only comparing one's behavior to others, but having common information about which peers did/did not adopt a particular MP. Currently green nudges that inform households of average peer behavior do not enable consumers to infer which of their peers adopted green behavior. As such, adopters of MPs cannot gain social recognition for their actions. Such interventions thus cannot be used for green signalling among consumers. Obviously, privacy issues will have to be addressed in any modification that enables peers to identify which of their peers adopt MPs. This could be done by, for example, households voluntarily opting into a program that publically lists the top green friendly households in the local area. Another deeper point is that the consumer's own social environment is an important source of cues that can trigger consumer to reflect on their behavior (Lades, 2014; Binder and Lades, 2015). Enabling the local social environment to trigger changes in consumer behavior in this way may represent a more ethical ‘hands-off’ approach to fostering green preferences, relative to the situation in which policymakers determine the frequency of the consumer's exposure to cues.

Finally, we found evidence that social learning processes can help overcome the value-action gap. Irrespective of whether the imitation process is driven by learning or signalling, social influences seem to only affect those who are strongly concerned about climate change to act on these concerns, thereby reducing the observed difference between concern levels and the propensity to act. On the other hand, peer influences appear to have little impact in reducing the value-action gap among those who care little about climate change. This asymmetric impact on the population of consumers result suggests that concerns about overtly pressuring consumers into adopting MPs appear to be misplaced. In addition, these studies have also shown that the consumption spillovers related to the imitation of green behavior are limited to visible MPs. In this sense, these adoptions could be potentially reversible in the sense that future anti-environmental changes in peer behavior could reverse such adoption patterns. More research need to be undertaken into how permanent green imitation patterns are, as well the manner in which spillovers can be extended into non-visible domains.

Concerning directions for future research, this study has used cross sectional results to study the influence of peer behavior on the adoption of MPs. It would be useful for future studies to use time series data on individual behavior to seek more evidence for green imitation and behavioral spillovers in a dynamic setting. A fascinating but rather crude start to examining the dynamics green behavior has been made Melo et al. (2018) who only have data on two observed time periods.[20] Given data on migration patterns across regions, it would be interesting to

[20] Another interesting study using panel data is by Binder and Blankenberg (2017) that considers how the value-action gap is related to subjective well-being.

examine whether people migration between regions vary the number of MPs adopted according to changes in their social environment. In addition, similar to Heffetz (2011), it would be useful to empirically develop an accurate assessment of what type of MPs are considered visible by agents and whether there was any variation in the types of MPs considered to be visible across different age groups, regional areas and social networks. Finally, future survey work could consider examining how the propensity to adopt MPs relate to the structure of consumer lifestyles, which could measured by examined using question about the type of consumption routines individuals follow in major consumption domains and their implications for the adoption of MPs.

5. Conclusion

This paper examined how the observation of peer green behavior in the local environment encourages agents to imitate such behaviour by adopting climate change mitigation practices. We find evidence that there exists a tendency for consumers to imitate visible green behavior of their peers. However, the manner in which this imitation takes place is not straightforward in the sense that consumers do not appear to adopt precisely the same type of mitigation practices as what they observe. Rather, it appears imitation takes place in a manner that consumers adopting one of a range of MPs available to them. This spillover effect is, however, limited in its scope to those MPs that are visible to others. It does not extend to non-visible consumption practices. This result suggests that signalling behavior seems to be an important consumption motive associated with the green imitation of peers. All in all, this study has underlined the need to further study the complex ways in which the social environment and peer behavior can shape consumers learning patterns and the individual's propensity to act on their concerns about climate change.

Appendix A

Table 4A
ANOVA Results on the regional clustering of MPSs– Sensitivity check 1 – public transportation, air travel and carpooling dropped from the analysis.

A: Three-digit aggregation

	ANOVA			Bartlett test		
	F	Total degrees of freedom	P value	χ^2	Degrees of freedom	P value
Action	1.11	3013	0.125	160.78	194	0.961
Visible	1.21	3013	0.016	115.69	185	0.999
Non-visible	1.10	3013	0.151	146.72	190	0.991

B: Two-digit aggregation

	ANOVA			Bartlett test		
	F	Total degrees of freedom	P value	χ^2	Degrees of freedom	P value
Action	1.05	3013	0.381	39.89	50	0.846
Visible	1.42	3013	0.025	27.44	50	0.996
Non-visible	1.01	3013	0.467	50.69	50	0.446

Table 4B
ANOVA Results on the regional clustering of MPs – Sensitivity check 2 – recycling reclassified as non-visible.

A: Three-digit aggregation

	ANOVA			Bartlett test		
	F	Total degrees of freedom	P value	χ^2	Degrees of freedom	P value
Action	1.13	3013	0.089	174.09	196	0.868
Visible	1.31	3013	0.001	169.72	188	0.826
Non-visible	1.13	3013	0.088	171.26	193	0.868

B: Two-digit aggregation

	ANOVA			Bartlett test		
	F	Total degrees of freedom	P value	χ^2	Degrees of freedom	P value
Action	1.28	3013	0.084	38.05	50	0.892
Visible	1.93	3013	0.000	57.46	50	0.218
Non-visible	1.07	3013	0.343	59.83	50	0.161

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